ABSTRACT

The air-cooled argon gas laser system includes a safety interlocking laser head, compact power supply, and cooling fan assembly. The laser head and power supply are connected by an umbilical cable, and the cooling fan is driven by the laser head. The system is air cooled by internal cooling fins, a chassis mounted cooling fan assembly or an optional external cooling fan and a connecting flexible duct. The user's manual has been provided to aid in successful installation and safe operation of the argon gas system. Basic system maintenance and troubleshooting are covered to assist in continued system performance.

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NOMENCLATURE

~	- Approximately
Amp	- Ampere
ANSI	- American National Standards Institute
CDRH	- Center for Devices and Radiological Health
Collateral Radiation	- Scattered emission from laser beam
FDA	- Food and Drug Administration
ft	- Feet
Hz	- Hertz
IEC	- International Electro-technical Commission
mW	- Milliwatts
nm	- Nanometers
OSHA	- Occupational Safety & Health Administration
RMS	- Root mean squared
Safety interlock	- A mechanism which prevents laser operation when the interlock is open
V	- Volts

1. INTRODUCTION

Congratulations for choosing an LS series ion laser for your application. The LS series represents the latest iteration of our air-cooled argon/krypton lasers which have evolved over 28 years to become very efficient and cost effective. The LS series features high reliability, stable and repeatable beam characteristics, and excellent thermal management. In addition, the resonator adjustments are self-locking to maintain alignment and pointing stability during shipping and operation. Configurations include multi-line, single line, and tunable wavelengths that span the spectrum from 457nm to 677nm, local or remote cooling, and A.C. or optional D.C. heated plasma tube cathodes. The highly efficient, low noise power supply incorporates power factor correction circuits, and a simple plug-in card for measuring and adjusting plasma tube current, optical power, and setting the system in either light control or current control modes. The optional Remote Power Control console, features adjusting knobs, switches and an easy-to-read LCD display of all laser parameters and settings. The LS series is CE certified, and meets appropriate international standards.

LS SERIES MODELS

Model	Power	Wavelength	Beam Dia.	Divergence	Mode
LS100BY	10mW/line	488/568	1.0mm	1.5mrad	TEMoo
LS100WL	10mW/line	488/568/647	1.0mm	1.5mrad	TEM00
LS100YK	50mW	568 single line	1.0mm	1.5mrad	TEMoo
LS300A	300mW	457-520 multi	0.8mm	1.0mrad	TEMoo
LS300B	140mW	488 single line	0.8mm	1.0mrad	TEMoo
LS300G	140mW	514 single line	0.8mm	1.0mrad	TEMoo
LS300T	200mW at (488or 514)	Tunable 457nm-514nm	0.8mm	1.0mrad	TEMoo
LS300TM	225mW	Tunable	1.4mm	1.6mrad	Multimode
LS300HB	200mW	457-496	0.8mm	1.0mrad	TEMoo
LS300AM	500mW	457-514	1.4mm	1.6mrad	Multimode
LS300BM	200mW	488 single line	1.4mm	1.6mrad	Multimode
LS300GM	200mW	514 single line	1.4mm	1.6mrad	Multimode

This manual describes basic operation of the argon gas laser system. Read this manual thoroughly and understand its content before attempting laser operation. Failure to do so could result in damage to your system, persons, or property.

The user's manual is written in sections dealing with laser safety, product information, installation, system operation, maintenance, and basic troubleshooting. The intent of this manual is to provide the user with the necessary information to assemble and operate the argon gas ion laser system.

Basic maintenance is suggested for continued long-term use of the argon gas laser system. Maintenance instructions are given in section six and should be followed regularly. In addition a brief troubleshooting guide can be found in section seven.

Technical service procedures can be found in the American Laser Corporation Service Manual. Technical service procedures are beyond the scope of the User's Manual. **ONLY** qualified service personnel should perform service procedures beyond basic maintenance as described in the User's Manual.

2. LASER SAFETY

The argon gas laser system is designed with a safety interlocking cover and beam shutter to minimize exposure hazards. The system operator must know and understand all operating procedures for this product and exercise necessary precautions to assure safe and reliable service. Use of protective eyewear and other safety procedures is dependent on the conditions of use and the visual functions required. Consult OSHA and ANSI user standards for further guidance.

Emission indicators are provided on the power supply and laser head to warn the user when the laser beam is being emitted from the laser head. The color of the indicator light is red, in the visual range of 600 to 700 nanometers. When using eye protection the user should not use a filter that would block out the visual emission indicator signal. A safety interlock is provided on the power supply that allows the user to connect a remote switch that interrupts the laser when actuated (typically mounted on an entry door).

2.1 Safety Warnings:

WARNING:

Protective housings should not be removed during installation or operation. The power supply and laser head contain electrical circuits that operate at extremely high voltages. THESE VOLTAGES ARE LETHAL. All service and/or maintenance should be performed only by authorized American Laser Corporation service personnel. Customers should not attempt to perform maintenance and/or service beyond that described in the User's Manual.

WARNING:

During installation and/or operation of your laser, use extreme caution to avoid possible exposure to laser or collateral radiation in excess of the accessible limits listed in the Federal Register, 21 CFR 1040.10 (4-1- 96 Edition); Tables I, II-A, II, III-A, III-B, IV, V, and VI.

In accordance with FDA CDRH requirements, the argon gas laser system is equipped with safety caution and warning labels. In accordance with IEC requirements, and in conjunction with a CDRH variance for export, caution and warning labels are black on a yellow background. Laser classification is based on CDRH standards. Manufacturer, model, and power requirements are provided on manufacture's label. Labels are located as shown in figures 1 - 4.

External connectors are marked with an exclamation label to warn the user of possible shock hazards. Special care should be used whenever these connectors are exposed. The user should never touch any exposed connector, or allow foreign material to come in contact with any connector. Failure to follow these warning precautions could result in high voltage electrical shock, personal injury, and damage to the laser system.

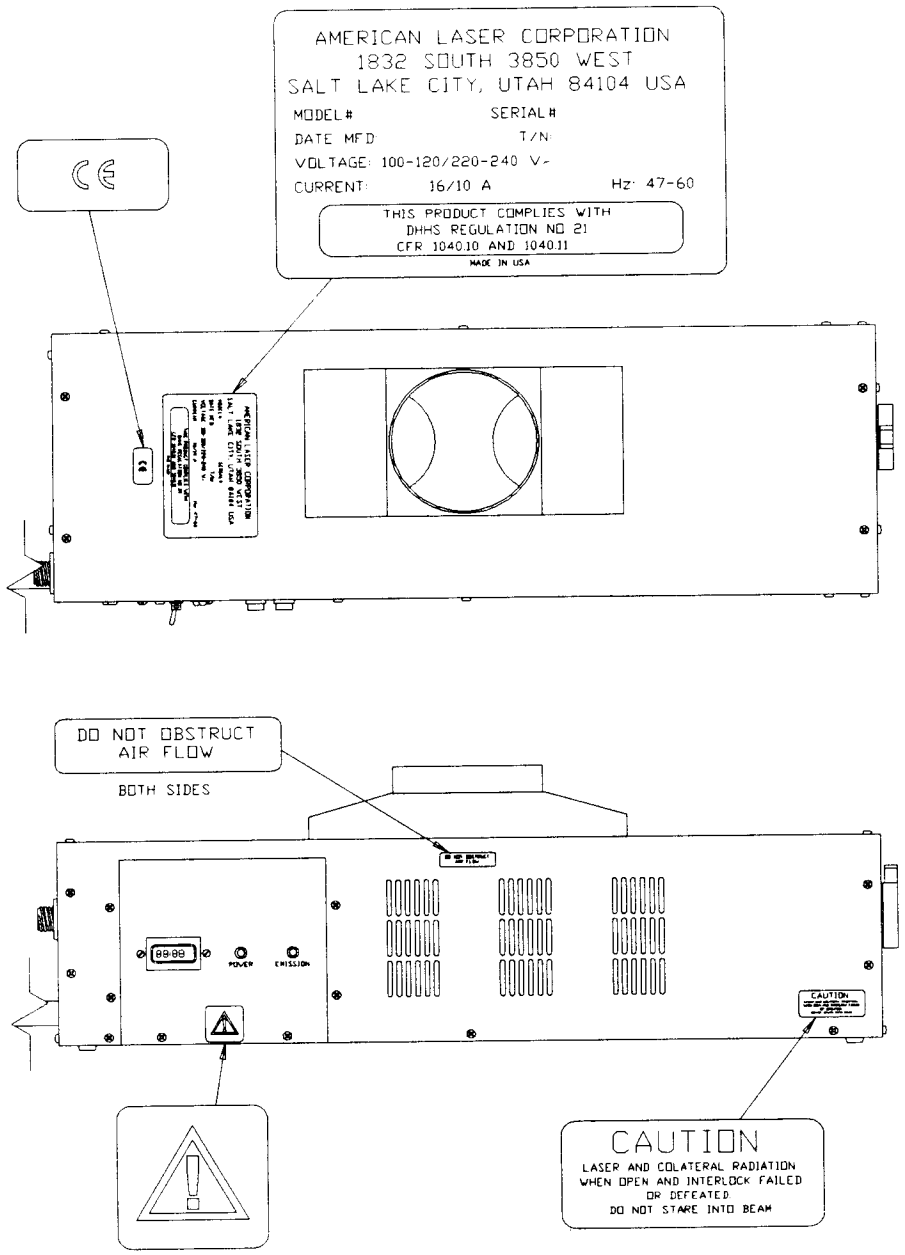

Figure 1: Laser Head with remote cooling option

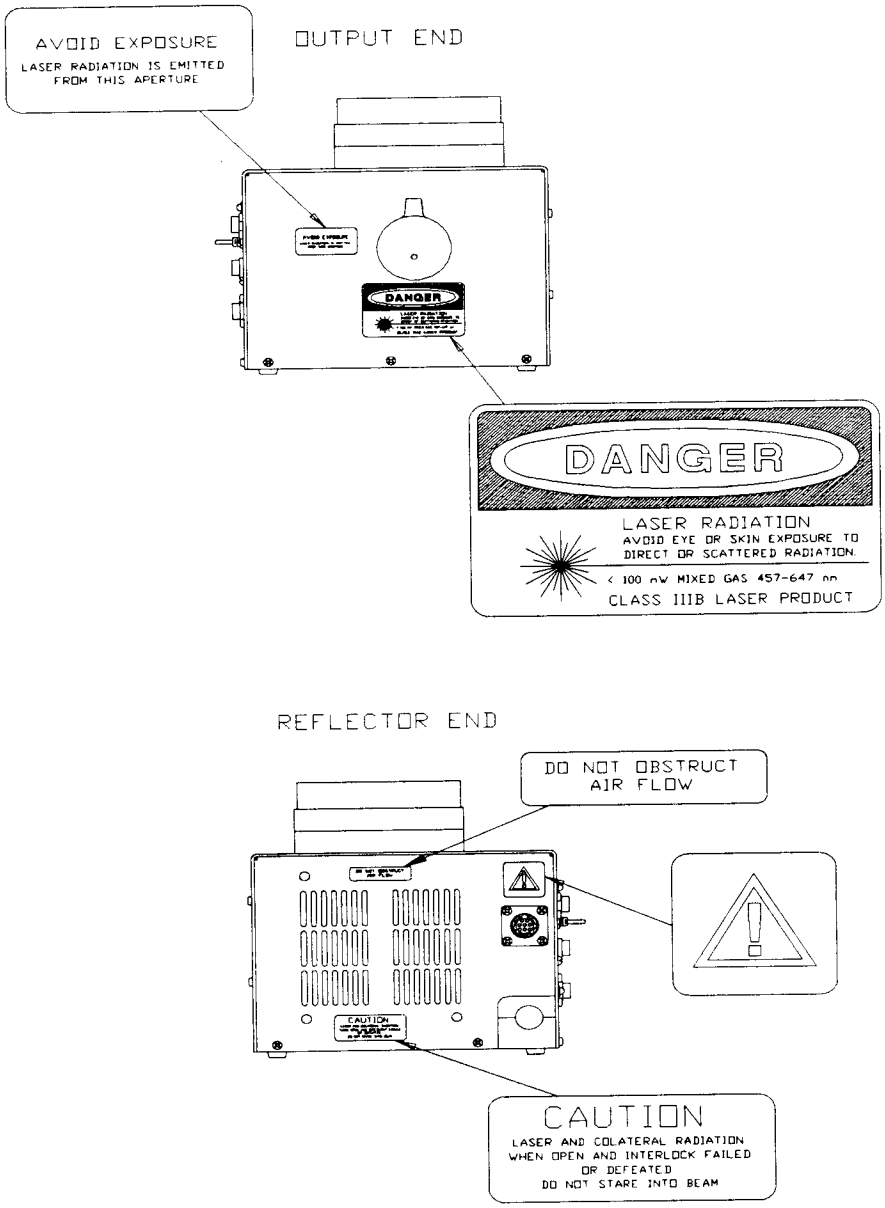
AVOID EXPOSURE
LASER RADIATION IS EMITTED FROM THIS APERTURE
OUTPUT END
DANGER
DANGER
LASER RADIATION
AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION.
< 100 mW MIXED GAS 457-647 nm
CLASS IIIB LASER PRODUCT
REFLECTOR END
DO NOT OBSTRUCT AIR FLOW
CAUTION
LASER AND COLATERAL RADIATION WHEN OPEN AND INTERLOCK FAILED OR DEFEATED
DO NOT STARE INTO BEAM

Figure 2: Laser Head

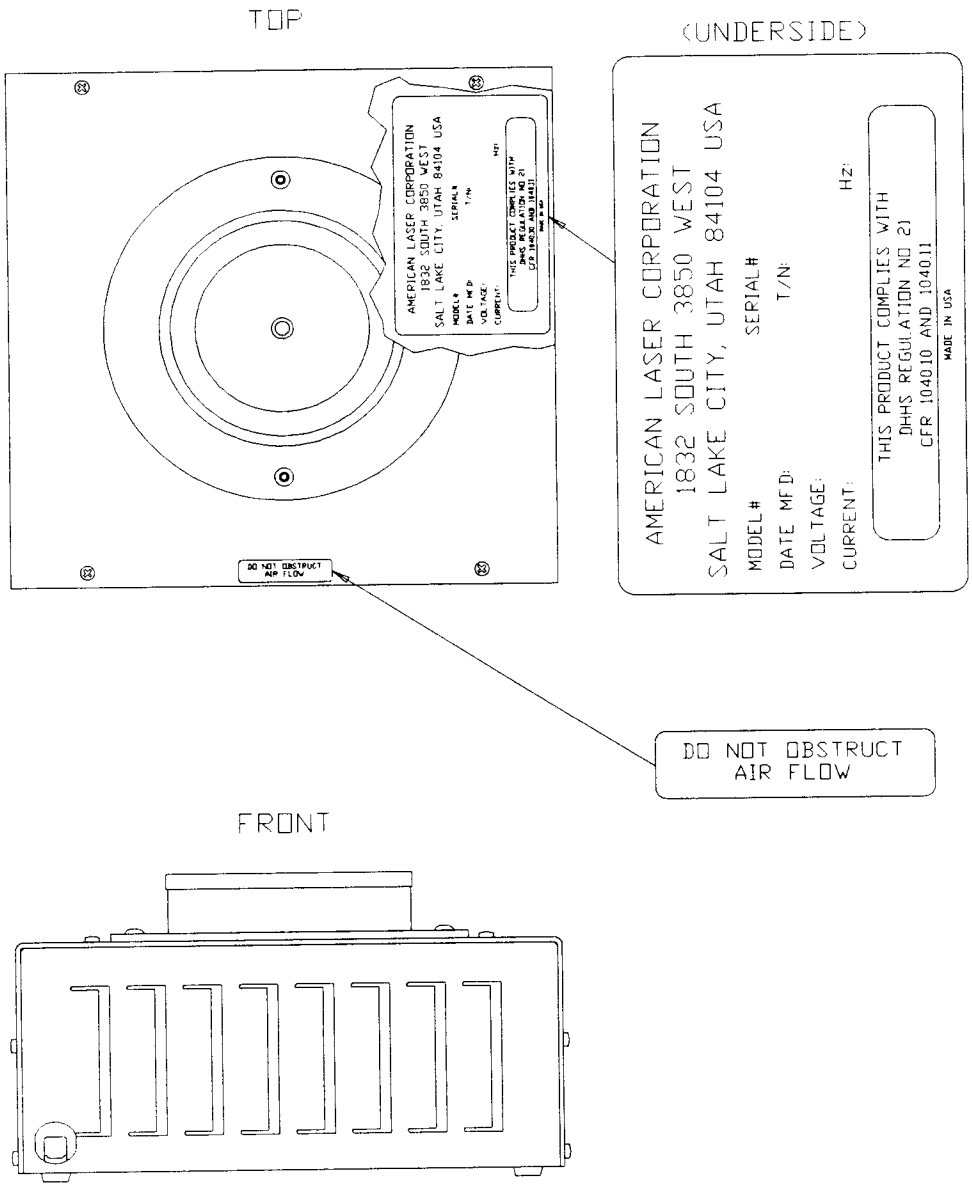

Figure 4: Optional Remote Cooling Fan Assembly

2.2 Safety Procedures:

CAUTION:

USE OF CONTROLS, ADJUSTMENTS OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS RADIATION EXPOSURE. LASER USERS SHOULD PRACTICE EXTREME CAUTION WHEN OPERATING THE LASER, ESPECIALLY AT HIGH OUTPUT POWER LEVELS, TO AVOID INJURY TO THOSE PRESENT DURING OPERATION. THE FOLLOWING LASER SAFETY PRECAUTIONS ARE ESPECIALLY IMPORTANT AND MUST BE FOLLOWED.

1. NEVER look directly into the laser beam or at the reflection of the beam from any surface.

2. Set up controlled access areas strictly for the operation of the laser. Allow access ONLY to required personnel who have been instructed in the safe operation of the laser and who are equipped with proper safety devices.

3. Post warning signs in prominent locations near laser operating areas.

4. Provide an enclosed path for the laser beam.

5. Set up experiments such that the laser beam is NOT at eye level. Permanent damage can occur to the eye with only a fraction of a second exposure to the beam.

6. Set up a target for the laser beam to help avoid accidental exposure to beam radiation.

-NOTICE-

Reasonable care must be used to avoid hazards. American Laser Corporation expressly disclaims responsibility for loss or damage caused by the improper use of its products.

AMERICAN LASER CORPORATION'S LIABILITY FOR DAMAGES SHALL NOT EXCEED THE PAYMENT, IF ANY, ACTUALLY RECEIVED BY AMERICAN LASER CORPORATION FOR THE UNIT OF PRODUCT OR SERVICE FURNISHED, OR TO BE FURNISHED, AS THE CASE MAY BE, WHICH IS SUBJECT OF CLAIM OR DISPUTE. IN NO EVENT SHALL AMERICAN LASER CORPORATION BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL, SPECIAL DAMAGES, OR THIRD PARTIES FOR BODILY INJURY, INCLUDING DEATH. AMERICAN LASER CORPORATION DISCLAIMS ALL EXPRESSED OR IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE, USE, APPLICATION OR FOR ANY SPECIFIC MODE AND/OR POWER OUTPUT AT ANY PARTICULAR WAVELENGTH, AND OF ALL OTHER OBLIGATIONS OR LIABILITIES ON THE PART OF AMERICAN LASER CORPORATION, UNLESS SUCH WARRANTIES, OBLIGATIONS, OR LIABILITIES ARE EXPRESSLY AGREED TO IN WRITING BY AMERICAN LASER CORPORATION.

3. GENERAL INFORMATION

3.1 Product Description:

The American Laser argon gas model is a fully safety interlocking air-cooled ion laser system consisting of a laser head, power supply, and cooling fan. The argon gas model is a compact precision system featuring power stability and high reliability. The argon gas model delivers a constant beam of light at specified wavelengths within the range of 457nm to 514nm, 10-300 milliwatts.

3.2 Laser Head:

The laser head contains an air cooled plasma tube constructed of a metalized beryllium oxide bore, providing a rugged, highly heat conductive unit, and insuring prolonged tube life. The resonator assembly is designed to provide stable power output at operating temperatures. Resonator adjustments are self-locking to maintain alignment and stability during shipping and operation.

The laser head is connected to the power supply via an umbilical cable located on the back of the head. A connector located on the rear panel provides direct current power for the optional remote cooling fan assembly.

Cooling of the laser head is provided as the fan assembly draws air over cooling fins in the laser head. A thermal switch cuts power to the tube in the event that temperatures exceed operational limits. When the head returns to operating limits the thermal shutoff resets automatically.

All optics are sealed in secure mounting assemblies. Optical assemblies are kept free from foreign debris and moisture with the use of sealed boots and dryers.

The laser head is equipped with a beam safety shutter and a cover safety interlock switch to reduce operator exposure to emitted and collateral radiation. The user accepts full responsibility for safe operation of the laser head in accordance with all safety procedures and regulations.

3.3 Power Supply:

The power supply is equipped with power factor correction circuits and series pass secondary regulation for high stability and low noise. Controls and indicators include power switch & LED indicator, an emission on/off key switch and LED indicator, a thermal power breaker, an interface connector, and a threaded umbilical connector. Cooling is provided by an internal fan and forced air convection.

3.4 Cooling Fan:

The standard configuration includes chassis mounted cooling fans. The optional remote cooling provides a centrifugal impeller that draws air through the head and cooling fan assemblies. The cooling fan and laser head are connected by a flexible duct which mounts to airflow brackets on both assemblies. The operating voltage for the fan is supplied from a connector on the rear panel of the laser head.

Caution should be used around fan and airflow brackets to prevent loose debris from entering the fan assembly and causing damage or injury. The user should also be aware of the supply voltage connector on the laser head and avoid possible shock hazards.

3.5 System Specifications:

OUTPUT POWER (TEM00):
100mW @ anode current < 8.5 Amps, 300mW maximum(MULTI-LINE)
(<10.5 final)

WAVELENGTH:
Model specific. Range is 457nm to 514 nm

BEAM DIAMETER:
0.8 mm

BEAM DIVERGENCE:
1.0 μrad

BEAM POLARIZATION RATIO:
> 100:1, Vertical

BEAM POINTING STABILITY:
< 30 μrad after warm-up

MAXIMUM LIGHT CONTROL:
10.5 Amps

POWER MONITOR VOLTAGE:
0.01 V/mW

OPTICAL NOISE (10 Hz - 1 MHz):

<2% peak to peak
<1% RMS
@ 100 mW

*INPUT VOLTAGE:

Supply dependent,110 or-240 VAC

LOW LINE STARTUP:
The unit must start at the minimum line voltage in the range minus 10%

EXTERNAL TEMPERATURE:
No external surface to exceed a temperature of 60° C.

FREQUENCY:
47 - 60 Hz

CURRENT:
20 A

OPERATING ENVIRONMENT:
Temperature
10 - 40 °C

Relative Humidity
0 - 90% non-condensing

Altitude
0 - 10,000 ft

1. Specifications represent general performance of standard models.

2. Design and specifications subject to change without notice.

* Read section 4.2 prior to switching line voltage.

4. INSTALLATION

Special care should be taken to insure that every component is properly oriented and connected.

4.1 Unpacking and Inspection:

An assembly drawing is provided in Figure 5 for system installation. Figure 5 also lists the components included with the argon gas system.

The laser system is shipped in two separate packages. One package contains the laser head, and the other contains the power supply, cooling fan, cables, flexible hose, and system specification test certificates. If the shipping boxes are damaged, ask the carrier's agent to be present when the instruments are unpacked. Remove all components from the boxes and inspect for damage (scratches, dents, etc.). If any of the instruments are damaged or fail performance checks, notify an American Laser Representative. Retain the shipping boxes and padding materials for the carrier's inspection.

American Laser has designed special packages to securely hold the laser system during shipment. If a laser must be returned for service, we recommend that American Laser containers be used.

4.2 Power Requirements:

The laser system operates in the AC voltage ranges listed in the system specifications. Whenever the line voltage is switched to a new range, the system must be shutdown for ten (10) minutes before applying the new line voltage.

The system should be properly grounded for safe operation. Users are cautioned to ensure that the operating voltage stays within listed specifications.

4.3 System Connections:

4.3.1 The AC Connector:

The 3-pin connector on the power supply is for AC input. The AC input plug and cord should be installed by qualified personnel in accordance with all appropriate national electrical codes and EN61010-1

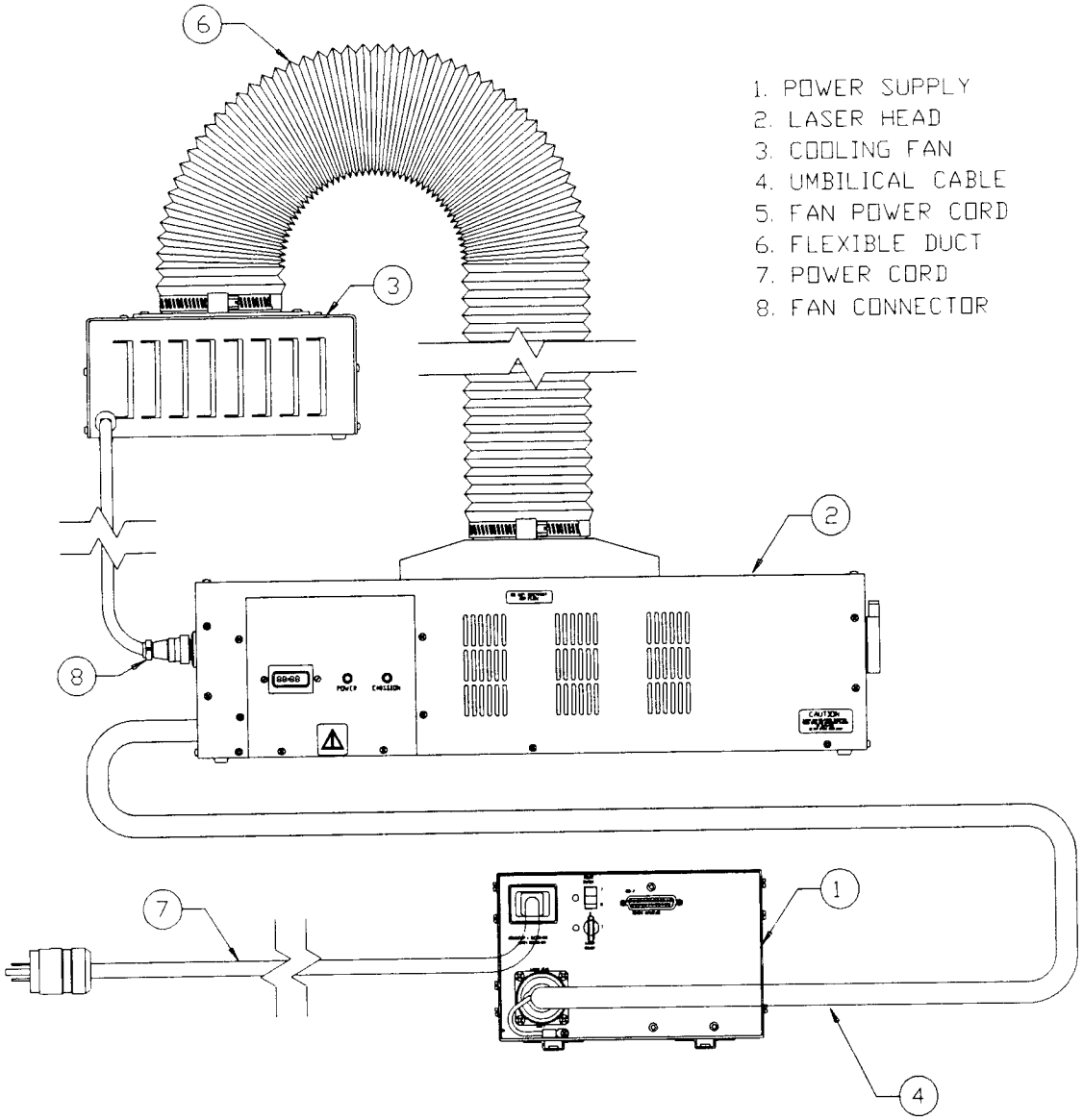

Figure 5: System Assembly (with optional remote cooling fan assembly)

4.3.2 The Umbilical Cable:

Connect the laser head to the power supply using the large cable attached to the back of the head. This cable has a 22-pin plug which connects to the power supply. The umbilical connector includes a ground wire which must be mounted to the power supply cover as shown in figures 5 & 6.

4.3.3 Optional Remote Cooling Fan:

Connect the power cord for the fan to the rear panel of the laser head. Attach the flexible duct between the fan and laser head airflow brackets. Use hose clamps to secure both ends of the duct.

4.4 System Cooling:

4.4.1 Laser Head:

The laser head is cooled as air is drawn through the laser head, optional flexible duct, and cooling fan assembly. Heat is transferred from the head by cooling fins on the laser tube. The length of the connecting hose may be stretched up to 7 feet to allow remote placement of the fan assembly.

When installing the laser system, allow adequate room for airflow in and around all air vents. Obstructing airflow could reduce cooling efficiency. Caution should be used around air vents and hose mountings to prevent loose articles from entering the laser head or fan assembly.

4.4.2 Power Supply:

The power supply is cooled by an interior fan, heat sinks, and forced convection. Install unit such that air passages are not obstructed during system operation.

4.4.3 Thermal Cautions:

As the laser system is operated in a continuous mode, external surfaces may tend to heat up. These surfaces may become very hot to the touch. Caution should by used around all heated surfaces. After the laser head has been turned off, surface heat will dissipate quickly as the cooling fan is allowed to run.

5. SYSTEM OPERATION

5.1 Laser System Controls:

Figure 6 shows the location of system controls.

The power supply is equipped with a thermal breaker for main power control. In the event of excessive power draw the breaker will terminate system operation. The power supply key switch must be in the on position prior to laser emission. The key may be removed in the off position to prevent accidental beam exposure. Emission indicators are provided on the power supply and laser head to warn the user when laser radiation is being emitted from the system.

A separate power supply manual is incorporated in this document. Laser output power may be adjusted at the power supply by use of the test PCB or optional remote power control console. Test point jacks are located on the PCB to monitor laser power, cathode voltage, and anode current. The remote power control console provides an LCD that displays current selected values which may be adjusted with the console controls. The console is connected to the supply through a sub-d connector. An interface cable allows the remote console to be located at considerable distance from the system.

Deleted through revision A

5.3 Remote Interlock:

A remote safety interlock switch may be added to the laser system at the users discretion. The safety interlock prevents laser beam emission whenever the interlock is opened. Pins and on the power supply remote interface connector PC board may be modified by attaching a twisted pair, 22 gauge. The user may then add a remote interlock switch between pins and . After modification, secure the wires by using a tie-wrap to the PC board.

5.4 Turning On The Laser System:

Make one last check of all connections to ensure that each is properly connected and securely fastened. With safety interlocks closed, fan assembly connected, and head temperature within operating range, the argon gas laser system is ready to be turned on.

Switch thermal breaker to the on position. Turn the key switch to the on position. The "Power On" indicator light will come on. The "Emission" indicator will come on and the laser tube will light. If the key switch is turned off at any time, allow at least thirty (30) seconds before switching back to the on position. (See System Shutdown.)

5.5 System Shutdown:

To properly shutdown the laser system, turn key switch to the off position. If the key switch needs to be turned back to the on position, wait at least thirty (30) seconds to allow transient voltages to drain. Failure to wait thirty (30) seconds may render the power supply cooling fan non-operational, and prevent system ignition.

Allow cooling fan to run until the laser head has cooled off sufficiently and the cooling fan shuts off automatically (approximately two minutes). After the fan has stopped running, shut off main power to the system by switching the thermal breaker to the off position.

6. BASIC SYSTEM MAINTENANCE

The argon gas laser system has been designed to require a minimum of service. There are a few routine checks and procedures that may enable the user to prevent unexpected system down time. Technical service procedures may be found in the American Laser Corporation Service Manual. Technical service procedures beyond basic system maintenance should be performed ONLY by qualified service personnel.

6.1 Tube Life:

The best maintenance plan for long, useful laser service starts with operating the laser only when needed and utilizing the lowest power setting any time high power radiation is not needed. When the system will not be used for more than fifteen minutes, it can be placed in standby with the remote control console as it will achieve full power stability within sixty (60) seconds after power on.

6.2 Cooling System Maintenance:

It is very important that the laser tube is cooled properly. Periodic checks should be preformed to prevent fouling of cooling passages and ensure free airflow. Air filters are recommended if the laser head is to be used in a dusty environment.

6.3 Periodic Calibration and Adjustments:

Periodic calibration of the laser system may be required and should be performed by an authorized American Laser representative at least once a year. Calibration should be done in conjunction with general optics cleaning and alignment.

6.4 Field Emergency Alignment Procedure

Alignment of the laser head is more difficult when the laser action is not present. The primary objective must be to achieve lasing and then final alignment can be completed. It should be noted that the optical cavity is sealed, and should not require cleaning during normal use. If, however, this seal is broken, it is possible that the Brewster windows may be contaminated. Even a fingerprint on any optical surface will prevent laser action.

Each resonator plate has three resonator alignment nuts. The two nuts on a diagonal are to be adjusted and the third nut serves as a pivot point and should only be adjusted when

the two diagonal nuts by themselves cannot provide necessary power. The nut at the top of each plate adjusts the vertical alignment, and the nut on the diagonal opposite adjusts horizontal resonator alignment. The vertical and horizontal adjustment on the rear of the laser should be adjusted for maximum laser power prior to the final alignment or "Walking" of the resonator. The mirrors at each end of the tube define a beam path through the tube. If the mirrors are aligned with respect to each other, they may not be aligned with respect to the tube axis. "Walking" rotates the horizontal and vertical beam paths through the tube to correspond to the axis of the tube thus achieving maximum laser power and beam quality. To ensure proper alignment, use a short focal length lens to expand the output beam and check to see that a clean, round mode pattern appears.

Vertical Laser Beam Walking

A. Peak mirror alignment on the rear resonator plate using both vertical and horizontal adjustments. Observe laser power.
B. Rotate vertical adjustment on the front resonator plate clockwise to reduce laser Power by 10%.
C. Rotate vertical adjustment on the rear plate to restore laser power. If power greater than before adjustment, continue in clockwise adjustments until maximum value is reached.

Horizontal Beam Walking

A. Repeat steps A through c above using horizontal resonator adjustment screws.

7. BASIC TROUBLESHOOTING

SYMPTOM:	POSSIBLE CAUSE:
System will not turn on.	A. System not connected to power source.
	B. Circuit breaker is off on power supply or source.
	C. Key switch is off.
Power supply does not time-in.	A. Wait 45 seconds.
	B. Safety interlock on head is not engaged.
	C. Umbilical cable not properly connected.
Laser tube does not light.	A. Umbilical cable not attached.
	B. Head temperature exceeds operational limits.
Laser head overheats.	A. Cooling fan not connected or plugged into voltage source.
	B. Air flow vents blocked.
	C. Fouled air passages in laser head.
	D. High room temperature.
Low laser power.	A. User Interface Cable not connected.

For other system problems refer to an authorized service technician. Internal voltages are lethal and unauthorized service should not be performed by the user.

8. SUMMARY

After having read the User's Manual, the user may assemble and operate the argon gas air-cooled ion laser system. The safety procedures outlined in this manual should be practiced by the user whenever operating the laser system. Failure to follow safety procedures and required precautions could result in injury to persons and/or property. The User's Manual provides the user with necessary information for the installation and operation of the argon gas laser system, basic system maintenance, and basic troubleshooting.

Keep this manual for future reference and training of personnel who will use the argon gas laser system. For reference to technical service procedures beyond the scope of this manual, the American Laser Corporation Service Manual may be used by authorized service personnel.

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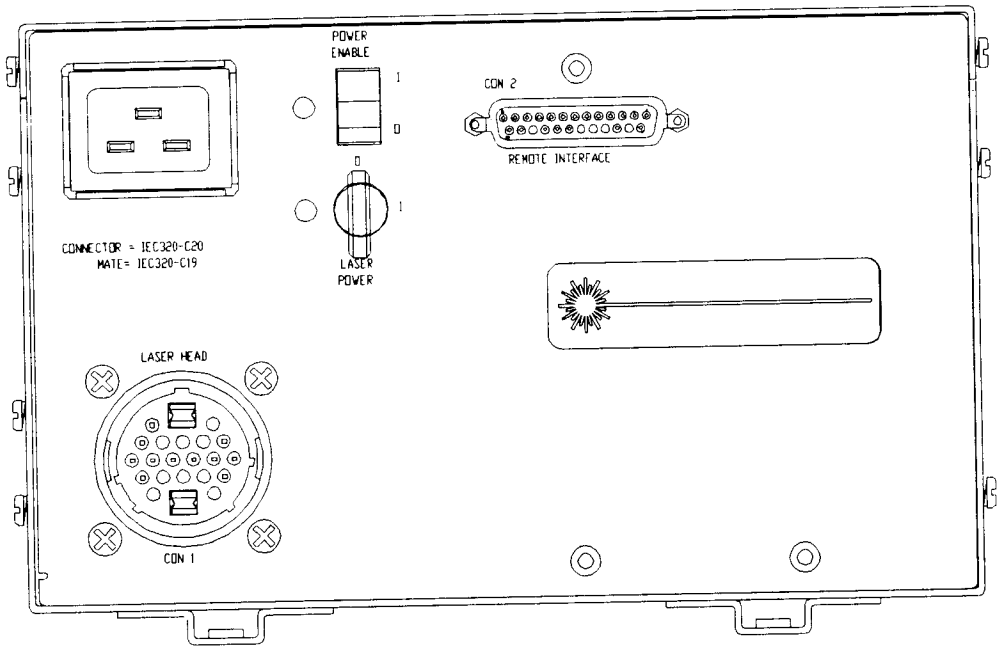
IEC Standard

Assembly Documentation, 1997
American Laser Corporation
Salt Lake City, Utah

ARGON LASER POWER SUPPLY

Instruction Manual



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Storage Specifications Page 27

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Laser Connector Pinout Page 31

Installation and Operation Page 33

INPUT SPECIFICATIONS

Nominal Line Voltages	100,110,125,200,208,230VAC @ 1.5KW Max Output 200, 208, 230, VAC @ 3KW Max Output
Selectable (+/- 5% at each tap)	90, 95, 100, 105, 110, 115, 120, 130, 190 200, 210, 220, 230, 240, 245, 250 VAC @ 1.5KW Output 190, 200, 210, 220, 230, 240, 245, 250VAC @ 3KW Output
Frequency	50/60 Hz
Line Voltage Tolerance	±10% of the nominal line voltage
Fusing two required (internal)	20 A
Earth Leakage Current at 240 VAC +10% 60Hz	3.5 mA
Output Holdup Time at minimum input voltage (50 Hz) and maximum anode current	> 10 mS
Input Current @ 230 VAC 3KW Output @ 115 VAC 1.5KW Output	 16 Amps Maximum 20 Amps Maximum
Input Power	< 3 kW
Power Factor Correction	Meets EN6100-3-2:1995
Efficiency	≥ 90%

OUTPUT SPECIFICATIONS

Operating Voltage Range (factory set)	70 - 110 VDC or 170 - 220 VDC
Operating Current Control Range for constant anode current	Standby to 12 ADC
Maximum Anode Voltage @ Start	350 VDC +/- 5VDC
Nominal Stand-by Current internally adjustable up to 4.0 ADC	4.0 ADC
Laser Ignition Delay	30 Seconds
Laser Head Fan Voltage	115 VAC Nominal

Operating Current Instability

ΔI/I in current control mode:

➢ after 30 minutes warm-up during 2 hours	< ±2%
➢ temperature variations from 10 to 50 °C	< ±5%
➢ line voltage variation of ±10%	< ±1%
➢ operating voltage range stated above	< ±1%

Laser Beam Optical Ripple

within the total mains voltage and operating current range in the current control mode

➢ at DC to 300 Hz	≤ 0.1% pp
➢ photo control mode	

Laser Power Instability < ±0.5%

< 20 Hz in light control mode after 5 minutes warm-up during two hours within the total mains voltage and operating current range as measured at the light amplifier output

Operating Voltage Delay after power supply switch-on, line failure or interlock circuit interruption	20 - 40 S
Heater Voltage at 20 A heater current and nominal line voltage at the laser interface connector without anode current	3.0 VAC @ 20 AAC
Maximum Heater Current	26 AAC
Auxiliary Voltages at 20 mA maximum current load	±15 ±5% VDC
Current Ramp	≤ 20mS (from standby to max I) 1mS/A ramp (light and current mode)
Interlock Voltage to laser head	24 VDC (optional latching)

NOISE SPECIFICATIONS

Light Intensity Noise with laser operating in light control mode	
➢ frequency range 10 Hz - 300 Hz	< 0.1% RMS
➢ for particular frequencies from 10 Hz to switching frequency	< 0.5% RMS
High End Cut-off Frequency (-3 dB)	≈7.0 kHz
Output Current Regulation (in current control mode)	
@ 7-126Hz	+/- 1.0 % p-p
@ 100 kHz	+/- 0.5 % p-p

OPERATING ENVIRONMENT

Temperature Range	10 - 40° C
Relative Humidity without condensation	< 80%
Altitude	3,000 m

STORAGE ENVIRONMENT

Temperature Range	–40 - 60° C
Relative Humidity at 40° C without condensation	< 90%
Altitude	< 12,000 m

MECHANICAL DATA

Package Weight	15 lbs. (6.75 kg)
Cooling 3.15" x 3.15" internal fan Forced air - air flow exits rear of supply ***Note: The fan in the laser head will remain ON for approximately 3 min. when the power supply is turned OFF using the key switch or the LASER ON/OFF command.	
Dimensions see drawing D80-759-P1 on page 30	8.69 × 11.22 × 5.7 in (22.07 × 28.50 × 14.48 cm)

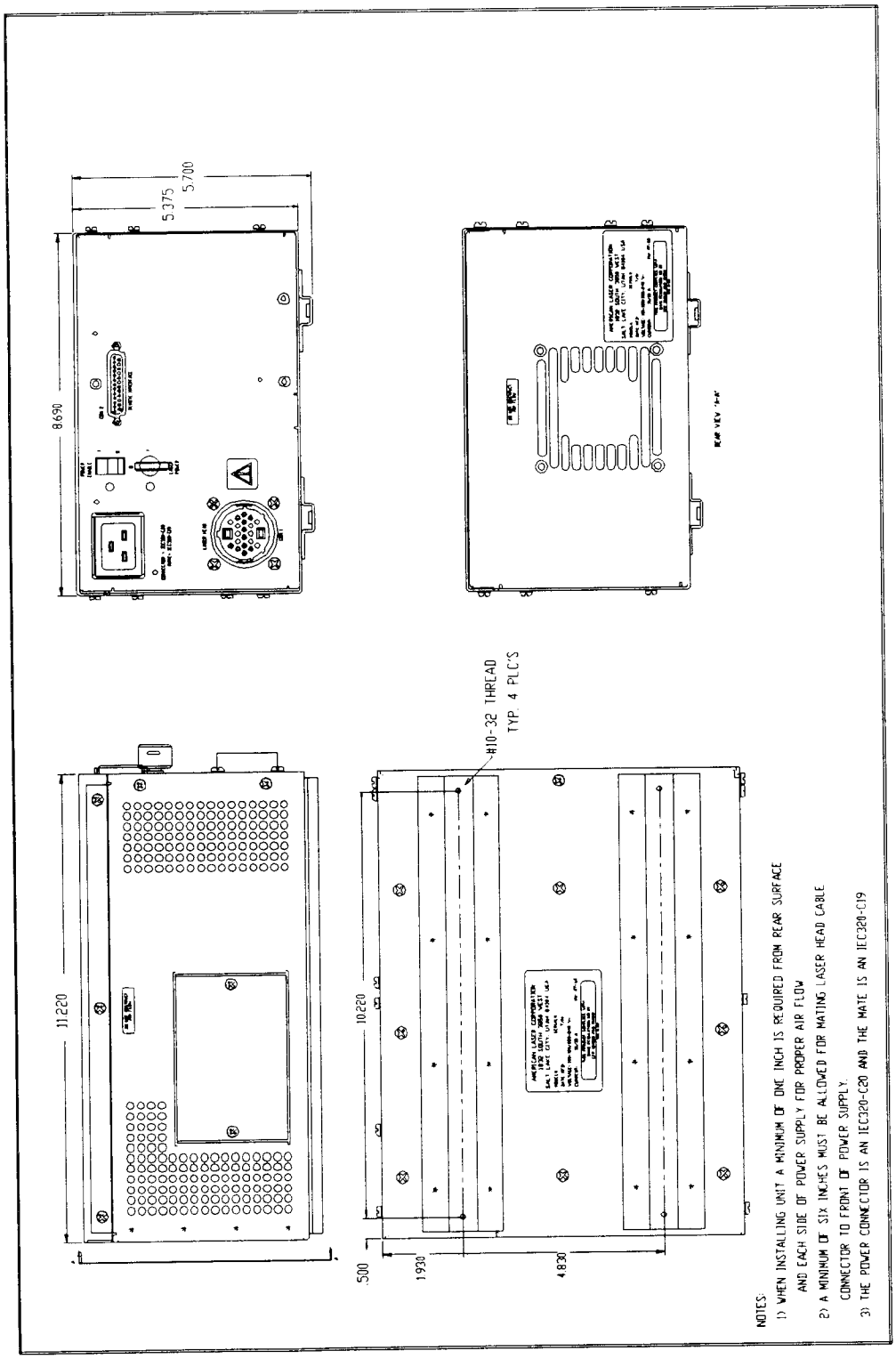
5.700
5.375
8.690
#10-32 THREAD
TYP. 4 PLC'S
11.220
10.220
.500
1.930
4.830
NOTES:
1) WHEN INSTALLING UNIT A MINIMUM OF ONE INCH IS REQUIRED FROM REAR SURFACE AND EACH SIDE OF POWER SUPPLY FOR PROPER AIR FLOW
2) A MINIMUM OF SIX INCHES MUST BE ALLOWED FOR MATING LASER HEAD CABLE CONNECTOR TO FRONT OF POWER SUPPLY.
3) THE POWER CONNECTOR IS AN IEC320-C20 AND THE MATE IS AN IEC320-C19

Table 1 REMOTE INTERFACE Connector (CON 2) Pinout

PIN	NAME	COMMENTS
1	INTERLOCK	Pins 1 and 3 must be shorted to each other to complete the INTERLOCK circuit. Optional Latching: Please note, the INTERLOCK circuit must be complete when the mains POWER switch (front panel) is switched to the ON position. If the INTERLOCK circuit is broken before or after the mains POWER switch is switched ON, the power supply will be disabled; this is a "latched" condition. To enable the power supply, the mains POWER switch must be switched OFF, the enable circuit completed, then the mains POWER switch can be returned to the ON condition. The keylock switch is not in the INTERLOCK chain. The keylock switch's function is enabled if the INTERLOCK chain is complete and the mains POWER switch is ON.
2[1]	DISCHARGE	Discharge ENABLE/OFF. Logic "1" - Discharge ENABLED. Logic "0" - Discharge OFF. A logic "0" on this line turns the laser tube's ionic discharge OFF (no lasing). The laser filament current is not interrupted, therefore the laser discharge can be returned to the ON (lasing) condition within 50mS of the discharge ENABLE command (logic "1"). Normally, this line is in the logic "1" (open) condition.
3	INTERLOCK	See PIN 1.
4[1]	STANDBY	Standby Not Standby/Standby. Logic "1" - Not Standby Logic "0" - Standby A logic "0" on this line puts the laser tube in the Standby mode. In the Standby mode, the laser operates at 3.0 to 4.0 Amps (adjustable) typically and the filament current is not interrupted. Under these conditions, lasing continues but the output power and stability are indeterminate. The laser may be returned to the previously selected operating conditions within 20mS of the Not Standby command (logic "1"). Normally, this line is in the logic "1" (open) condition.
5[1]	MODE	Select PHOTO/CURRENT controlled parameter. Logic "1" selects PHOTO (optical power) as controlled parameter. Logic "0" selects CURRENT (laser current) as controlled parameter.
6[2]	I CONTROL	Reference input for CURRENT (I) control mode. Input impedance = 20KΩ.
7[2]	mW CONTROL	Reference input for PHOTO (mW) control mode. Input impedance = 10KΩ.
8	mW SENSE	Laser light output power "mW" monitor. Reference = RETURN (Pin 10). Output impedance ≈ 100Ω.
9	I SENSE	Laser current "I" monitor. Reference = RETURN (Pin 14). Output impedance ≈ 100Ω.

Table 1 REMOTE INTERFACE Connector (CON 2) Pinout (Con't)

PIN	NAME	COMMENTS
10	RETURN	Reference level "0" volts.[3]
11	RETURN	Reference level "0" volts.[3]
12	–15VDC OUT	–15VDC @ 20mA maximum output. Reference = RETURN (Pin 11).
13	+15VDC OUT	+15VDC @ 20mA maximum output. Reference = RETURN (Pin 11).
14	RETURN	Reference level "0" volts.[3]
15		Not used.
16	DISPLAY	Display - 10 mV/mW
17-19		Not used.
20-22	RETURN	Reference level "0" volts.[3]
23	LASER ON/OFF	Logic "1" - Select laser ON after 30 second time delay Logic "0" - Select laser OFF.
24	RETURN	Reference level "0" volts.[3]
25	P. EARTH	Protective Earth

[1] These three pins are digital inputs. Each input has a "pull up" resistor to the internal +15VDC buss. A logic "1" (high) is "open circuit" or between +12 and +15VDC. A logic low is "shorted" to RETURN or between 0 and +3VDC. These inputs are compatible with "open collector" TTL outputs or CMOS outputs (when the CMOS gates are operated from a +15VDC supply), mechanical switches and relay contacts. However, they are most typically operated in a "hard wired" condition using manually placed shorting jumpers. Two shorting jumpers are supplied with the unit.

[2] These two pins are analog inputs. These inputs accept positive DC voltages relative to RETURN. Small signal broadband AC signals may be added to the DC command voltages resulting in modulation of the selected parameter. The "3db down" point in the frequency domain is approximately 7 KHz. The modulation depth should not exceed 10% of the DC level.

[3] All "RETURN" pins are floating with reference to P. Earth.

Table 2 LASER HEAD Connector (CON 1) Pinout

PIN	NAME	COMMENTS
1	FIL1 OUT	Filament heater and anode current return lines. Pins 1 and 22 provide 3.0 VAC @ 20 Amps (nominal) to the laser filament/cathode. Current sensing circuits monitor the filament current and disable the anode current if the filament "burns out". This feature prevents further damage to the rest of the laser following a filament "burn out" resulting in a less expensive repair for the laser.
2	ANODE OUT	Anode voltage and current. Pins 2 and 4 supply the current to the laser anode. The return path (cathode) for this current is the two filament heater lines (pins 1 and 22). The anode voltage is specified relative to the filament heater electrodes.
3	EARTH (PE)	Protective Earth
4	ANODE OUT	Anode voltage and current. See pin 2.
5		Not Used.
6, 7	EARTH (PE)	Protective Earth
8	+15 V	+15VDC to the laser head. Return = Pin 19 Used to operate a preamplifier for the optical power signal (pin 14).
9	NEUTRAL (Return)	Laser head voltage for pins #20,15
10	EARTH (PE)	Protective Earth.
11	INTERLOCK	Interlock circuit. Also - 15VDC. Return = Pin 19 Short to pin 12 to complete interlock circuit.
12	INTERLOCK	Interlock circuit.
13	LASER HEAD TRIGGER SIGNAL	Optional
14	BEAM +	Laser optical power signal. This pin carries the laser optical power signal to the laser power supply. The return line is pin 19. The bandwidth of the optical preamplifier must be at least 50kHz to avoid degrading the power supply's feedback loop.
15	115 or 230 VAC	Dependent on input tap selection range
16-18		Not used.
19	BEAM RET, SHIELD, ±15 RETURN	Reference level "0" volts. Isolated from earth.

Table 2 LASER HEAD Connector (CON 1) Pinout (Con't)

PIN	NAME	COMMENTS
20	115 VAC LASER HEAD FAN	For any input selected
21		Not used.
22	FIL22 OUT	Filament heater and anode current return lines. See pin 1.

INSTALLATION AND OPERATION

1 Location

1.1 In placing power supply allow 2" of clearance on either side for air intake and do not block rear of power supply.

2 Input Voltage Selection

2.1 If you need to change the input voltage either to a different range or more closely match your line voltage remove the side cover and follow the instructions on the access panel.

3 Connections

3.1 Connect laser head to CON 1.

3.2 Connect interface to CON 2 or jumper pins 1 and 3 to close interlock.

3.3 Connect power cord into power supply.

3.4 Plug power cord into outlet with 20A rating for 115vac or 16A for 230vac.

4 Power Up

4.1 Turn Power Enable switch "on". The red LED will illuminate and the green LED will be "off".

4.2 Turn Laser Power key switch "on". The green LED will illuminate if the interlock chain is complete. If green LED is not illuminated,turn key switch and power enable switch "off" and check interlock chain.

4.3 There will be an approximately 30 second delay before laser will light

4.4 Output power is adjusted by either an interface or a DC voltage to pins 7 (mW Control)or 6(I Control) ,and 10 (Return). The output can not be adjusted below the standby current nor over maximum limit.

5 Turning Power Supply Off

5.1 Turn Laser Power key switch "off".

5.2 The laser head fan will continue to run for approximately 3 minutes to cool down laser head.

5.3 Turn Power Enable switch "off" after fan has stopped.